RetroMeter: Milestone 3 Report

Exploring how the business model could be adopted by area-based retrofit facilitators or one-stop-shops around the UK & proposing a route for scaling-up.

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Glossary of Terms

ABS:	Area-Based Scheme delivered by a Community Intermediary
Aggregator:	The term "aggregator" is used throughout this report as shorthand for a Retrofit Aggregator who aggregates multiple retrofit projects from multiple Retrofit Providers (where available). This definition may overlap with aggregators of flexibility and other energy services, but may also support non-MES-enabled energy efficiency projects alongside MES-enabled schemes.
API:	Application Programming Interface. Application refers to any software with a distinct function. Interface can be thought of as a contract of service between two applications. This contract defines how the two communicate with each other using requests and responses.
ASHRAE:	The American Society of Heating, Refrigerating, and Air-Conditioning Engineers is an American professional association seeking to advance heating, ventilation, air conditioning and refrigeration systems design and construction.
BUS:	Boiler Upgrade Scheme (further explanation can be found in Section 3).
BS40101:	A British Standard that provides a basis for the verification of specified performance in new and upgrades buildings. This covers the planning of Building Performance Evaluation studies, data to be gathered and data storage.
BSI:	The British Standards Institution is the national standards body of the United Kingdom.
Contractor:	A retrofit contractor, often responsible for designing, coordinating, and installing the retrofit measures to buildings.
CalTrack:	CalTRACK is a set of methods for estimating avoided energy use, related to the implementation of one or more energy efficiency measures, such as an energy efficiency retrofit or a consumer behaviour modification. CalTRACK methods yield whole building, site-level savings outputs. CalTRACK methods are built off the OpenEEMeter solution, described and defined below.
Comfort Take Back:	Increased energy demand through changing occupant behaviour, namely increased use of their heating systems (or other core building systems such as lighting) following the retrofit. This increased consumption relates to restoration of a desired comfort level rather than through inefficient system operation.
CVRMSE:	Coefficient Variation Room Mean Squared Error
DCC:	Data Communications Company, which has design, built, and now manages the telecommunications technology infrastructure that underpins the smart meter roll-out in Great Britain.
DESNZ:	The Department for Energy Security and Net Zero
DNOs:	Distribution Network Operators - licensed companies that own and operate the electricity network from the National Gid intake (132kV) to

	the end users. Please note that whilst DNOs traditionally operate reactive or passive grids, in this case various forms of active management are discussed, usually segregated under the role of the Distribution System Operation (DSO). For simplicity, the term "DNO" will be used throughout this report as a catch-all for both DNO and DSO functions.
DW:	Data Warehouse (a detailed description can be found in the Data Warehouse Proposal report).
ECO:	Energy Company Obligation (further explanation can be found in Section 3)
EE:	Energy Efficiency - the process of reducing the amount of energy required to provide a set level of products or services.
ENWL:	Electricity North West
EPC:	Energy Performance Certificates (in context of houses)
ESCO:	Energy Service Company, which provides a range of services aimed at identifying, implementing and financing energy efficiency measures
FI:	Financial Institutions: Large investors or banks with primarily financial objectives
GFI:	Green Finance Institute
HUG:	Home Upgrade Grant (further explanation can be found in Section 3)
Implicit Flexibility:	Flexibility services arising from customer responses to price signals.
IPMVP:	International Performance Measurement and Verification Protocol
KPI:	Key Performance Indicator
LAD:	Green Homes Grant Local Authority Delivery scheme (further explanation can be found in Section 3)
M&V:	Measurement and verification
NHS:	The National Health Service
NMBE:	Net Mean Bias Error
O&M:	Operation and Maintenance
OpenEEMeter:	An open-source methodology of calculating avoided energy use, underpinning the CalTRACK methods.
OBI:	Outcomes-based investor: A provider of funds to deliver retrofits that is focused on outcomes rather than seeking a financial return. This could for example be an NHS Trust or a pure impact investor who may accept sub-market returns in projects with defined and measured social impact.
PAS2035:	This Publicly Available Specification is a British energy efficiency retrofit standard that creates a recognisable quality standard for the retrofit and energy efficiency sector for housing.

PB:	Public Bodies are local authorities that have sizeable assets that can be used to support their local community's health and wellbeing and tackle health inequalities, for example, through procurement, training, employment, professional development, and buildings and land use.
PPA:	Power Purchase Agreement (PPA) (long-term electricity supply contract agreement between two parties).
Recurve:	A commercial company in the US that helps utilities leverage their smart meter data and the OpenEEMeter methods to quickly and accurately measure energy usage and the impact of efficiency and demand flexibility on the grid.
RP:	Retrofit Providers. These are also referred to as retrofit one-stop-shops in the report, retrofit facilitators or community intermediaries, but retrofits are also provided by bodies such as Registered Housing Providers.
SHDF:	Social Housing Decarbonisation Fund (further explanation can be found in Section 3)
SIF:	Strategic Innovation Fund
SSB:	Standard Setting Body (as described in the Introduction of this report).
WHR:	Whole House Retrofit – in this case, this refers to the practice of taking a holistic retrofit approach which includes house-wide building fabric, key inefficiencies in core building services such as lighting and heating and a whole-house financing solution aligned with occupant needs. It should be noted that there are different definitions of this term for different organisations.

Executive Summary

This report explores the ways in which the Retrometer business model can be adopted by area-based retrofit facilitators or one-stop-shops around the UK, and proposes a route for scaling it up.

This report is split up into two main sections:

1. The first part of the report focuses on **the adoption** of the business model.
    a. This section highlights the key components of a Metered Energy Savings (MES) standard and describes its use cases for retrofit facilitators.
    b. The components described highlight the difficulties that retrofit facilitators anticipate facing when adopting a MES approach to retrofits, such as longer involvement with householders, more comprehensive data sharing agreements and changes to their current business models.
    c. These difficulties highlight the need for capacity building to support MES adoption. The section then evaluates the relevant forms of capacity building for each key stakeholder group in the MES ecosystem.
    d. The section concludes by discussing the practical approach to adoption and evaluating how centralised actors could assist with capacity building.
2. The second section of this report focuses on proposing a **scale up plan** for the Business Model.
    a. The section begins by examining the barriers to scaling up through the 5 Stages of Adoption, describing the key motivators for each adopter within two distinct customer segments: Funders and Householders.
    b. Following this, the factors that led to MES success in the US are explored, providing a framework for the scale-up plan needed to engage the wider UK audience.
    c. The scale-up plan ultimately explores the regional and national approaches to scaling up in the UK, examining ways to tackle barriers at a local level and leverage government schemes as a route to pilot large-scale retrofit projects at a national level, whilst supporting data collection efforts.

As it is anticipated that MES would be a standard of some form, contact was made with the BSI Retrofit Standards Task Group. The leadership of the Task Group has been briefed on the RetroMeter project and a slot secured at a future meeting of the entire Group, which is expected to be held in April. This ensures engagement with the British Standards institute as a key stakeholder for the RetroMeter Alpha phase.

Section 1: Introduction

The Strategic Innovation Fund (SIF) supported the RetroMeter project, which aims to advance the state-of-the-art of the UK's retrofit ecosystem by developing an open-source, replicable metered energy savings (MES) methodology.

Milestone 1 focused on reviewing prospective value streams and assessing their feasibility for incorporation into a delivery model for MES-enabled retrofits. Milestone 2 then focused on exploring the various stakeholder responsibilities at different stages of an idealised, quality-assured project development process (Appendix 1). This led to the development of a decision tree that mapped the key decision points to unlock, contract and capture the various value streams (Appendix 2). The decision tree highlighted the need for an over-arching, centralised body that would help to capture externalised value, distribute relevant project risks, and aggregate funding, leading to the creation of a business model canvas for an Aggregator.

Milestone 3 now focuses on how the Retrometer business model from Milestone 2 (MS2) can be **adopted** by area-based retrofit facilitators or one-stop-shops around the UK (Section 2) and proposes a route for **scaling it up** (Section 3). The primary condition for this wide-scale adoption and upscaling is the presence of an industry-accepted standard that defines the application of the MES methods that underpin the RetroMeter business model, therefore this report assumes a MES standard has already been established. The standard would deliver:

1. Standardisation: A standardised approach is one of the few ways to address systemic barriers across an industry, such as those that arise from the difficulties of measuring retrofit performance. A standardised approach defines the thresholds and limitations of compliance for participating suppliers, which can then be integrated into standardised retrofit programmes, such as those currently associated with government funding. The standardisation of certain elements of retrofit delivery (such as the length and methodology for post-project support, and the measurement & verification protocols that need to be adopted) ensures comparability and replication across many different retrofit providers, thereby "levelling the playing field", whilst also enabling flexibility in the structuring of non-standardised components such as the approach to engaging households.

2. Distribution of Risks and Responsibilities: The links between specific roles and responsibilities within a standard have already been validated through the PAS 2035 standard, which defines roles and responsibilities for the following Retrofit actors (Edwards, 2019): *Advisers; Assessors; Coordinators; Designers; Evaluators; and Installers*.

   It is proposed that the MES standard underpinning RetroMeter adopts and aligns to this approach, associating specific responsibilities with the actors or organisations best placed to manage and mitigate the resultant risks for each set of responsibilities. This approach ensures that all actors are incentivised to de-risk the most pertinent components of the project's development. In addition, this approach breaks the standard down into smaller, more "bite-sized" chunks for feedback, validation and

acceptance across whole industry supply chains and retrofit ecosystems.

3. Application and Association with other industry standards: Whilst a stand-alone standard for the MES methods underpinning RetroMeter would be valuable, the real catalyst for the adoption of MES methods would be their integration alongside other industry-accepted standards such as PAS2035 (Department for Energy Security and Net Zero, 2023). PAS 2035 is the overarching standard for retrofit, integrating the latest installation standard (PAS2030:2019), that is currently in place for the following government schemes, having been updated in 2023:
    - Energy Company Obligation (ECO)
    - Green Homes Grant Local Authority Delivery scheme (LAD)
    - Social Housing Decarbonisation Fund (SHDF)
    - Home Upgrade Grant (HUG)

Given the scale of these schemes and their funding, integration of an MES standard within the PAS 2035 requirements moving forward could unlock large scale MES pilots, actuarial data and centralised infrastructure to support MES methods, such as standardised data exchange through the Data Communications Company (DCC) or a Data Warehouse.

The RetroMeter consortium has engaged- and aligned with PAS 2035 requirements where possible, ensuring integration with the British Standards institute as a key stakeholder for the RetroMeter Alpha phase. This includes deployment of a 6-stage communications and engagement guide by Carbon Coop in the planned Social Housing Decarbonisation Fund in Manchester. In addition, as part of the project the RetroMeter consortium exchanged information with BSI and secured a slot at a future meeting of the Retrofit Standards Task Group, which is expected to be held in April.

Section 2: Adopting the RetroMeter Business Model

As discussed in the introduction to this report, the following sections will focus on the adaption and up-scaling of the RetroMeter business model in turn, beginning with an assessment of the conditions and processes required to enable the adoption of the RetroMeter business model by a range of Retrofit Providers and their stakeholders.

The components for an industry-accepted MES standard

The need for an industry accepted standard has been established and discussed in the introduction of this report; This section will now discuss the requisite components of such an agreed standard, and their use cases for various industry actors, as presented in Table 1 below:

Component of Industry-accepted Standard	Use Case / Requirement (non-exhaustive)
Input Data Requirements	• Input data requirements will be required to qualify target homes and households based on baseline and reporting period data sufficiency. • Input data requirements will help retrofit providers to specify their metering and monitoring solutions, along with resultant costs. • Input data requirements will impact the data privacy requirements of the platform. • Input data requirements will influence the set-up of the proposed data warehouse and its commercial / non-commercial use cases.
Data Transfer and Structuring Procedures	• Data transfer specifications will implement data privacy requirements of the platform, influencing how data is sourced, stored and translated from home monitoring solutions and meters, through the proposed data warehouse, to the retrofit targeting and evaluation models. • Data transfer procedures will influence how a partitioned data structure is implemented, determining how data can be stored at project, portfolio and fund levels. These partitioning approaches may also specify the approach for aggregating and anonymising key data points to preserve the privacy of the services' end-users. • Data transfer procedures will determine who will be able to access consumer data at various points in the project development lifecycle, impacting how DNOs, retrofit providers & anchor organisation target and pre-contract their retrofit scheme design.
Methodology Selection Approach	• Approach for calibrating and selecting the "best practice" model, based on indicators of model predictive performance such as Coefficient Variation Room Mean Squared Error (CVRMSE) and Net Mean Bias Error (NMBE). Calibration targets for these indicators should be aligned with industry best practice, such as that defined under ASHRAE Guideline 13. Which sets standards for NMBE and CVRMSE. • Approach for converting model accuracy, and indicators such as CVRMSE and NMBE into an expected uncertainty figure. For example, the following equation to quantify uncertainty is derived from the 2002 ASHRAE 14 guidelines (American Society of Heating, Refrigerating and Air-conditioning Engineers, 2002), codifying relative uncertainty (U - %) in terms of the t-statistic (t), the CVRMSE, the approximate percentage of baseline energy use saved (F), the number of baseline period datapoints (n) and the number of reporting period datapoints/periods (m): $$U = t \times \frac{1.26 \times CVRMSE}{F} \times \sqrt{\frac{n+2}{n \times m}} \qquad (5\text{-}7.1)$$ • Approach to use of adjusted or "back-up" models where the initial model selection proves to be unsuitable due to non-routine events, data insufficiencies or other unexpected factors.
Methodology Application Approach	• Approach for applying the selected methodology, including but not limited to: o Data pre-processing o Outlier identification and treatment o Comparison group matching or utilisation of pre-aggregated data o Model training and calibration o Model testing and cross validation o Assessment of accuracy and prediction results o Assessment of comfort takeback

	○ Evaluation and reporting of savings estimates and their certainty • Approach to documenting, summarising and communicating the application of specific energy consumption models at specific sites for the purpose of performance tracking, transparency and auditability.
Steering Committee and Governance Structure	• Description of how the standard can be modified over time, which will likely be managed through the steering committee, such as those established by the BSI (The British Standards Institution, 2024). Therefore, the steering committee should have defined parameters such as: ○ The scope and remit of the committee and its decisions ○ The frequency and format of meetings ○ The proposed participants and attendees ○ Any technical, financial or specialist working groups and their route to integrate their unique perspectives and feedback ○ The expected level of consensus to modify the standard or make changes; Approach to voting and consensus-building. ○ The expected level and approach for industry consultations • Participants and make up of governance structure(s) • Connection to other governance structures such as the British Standards Institute (BSI) and UK Government.
Association with other standards (i.e. PAS 2035)	• Approach to integrate and comply with other industry-accepted standards, namely the BSI's overarching retrofit standard, PAS 2035. However, PAS 2035 has also been "full incorporated into Trustmark", the UK government-endorsed quality assurance scheme that covers companies providing retrofit and energy efficiency services. Within PAS 2035, there are 6 key steps, which are described below alongside relevant alignments with the envisaged lifecycle and methodology underpinning a RetroMeter MES approach: 1. "Intended Outcomes": "Strategic Goals" and "KPI Commitment" stages of the proposed RetroMeter lifecycle. 2. "Risk Assessment": "Contracting", "Long list criteria" and "household discussions" stages of the proposed RetroMeter lifecycle. 3. "Whole Dwelling Assessment": "Target Households", "Site Shortlist" and "household discussion" stages of the proposed RetroMeter lifecycle. 4. "Design and Coordination": "Specification of Works", "Funding Approach", "Technical and Economic development" and "planning and consent" stages of the proposed RetroMeter lifecycle. 5. "Installation": "Installation and Completion Testing" stages of the proposed RetroMeter lifecycle. 6. "Monitoring and Evaluation": All "post project support" lifecycle stages. This is the step that RetroMeter would best be integrated in, but this would need to align or adapt the upstream steps to ensure that RetroMeter or other MES-enabled models represent a comprehensive end-to-end methodology that is compliant with PAS 2035. • Once the RetroMeter solution has been aligned with the PAS 2035 standard, it would be valuable to form a register of compliant providers, replicating the approach put in place by TrustMark, or integrated within the TrustMark register.
Industry Acceptance	• Whilst there may be formal consultation and consensus-building approaches within the acceptance of the proposed standard by industry actors, the following types of actors' acceptance will be required to offer a comprehensive solution to the UK's retrofit supply chain: ○ government ○ investors and lenders ○ outcomes-based funders (such as NHS Trusts) ○ Distribution Network Operators (DNOs). ○ Retrofit Providers ○ Public Bodies ○ Householders, homeowners and private tenant representatives ○ Retrofit Contractors & other PAS 2035 Retrofit Roles (*Advisers; Assessors; Coordinators; Designers; Evaluators; and Installers)*

The above requirements have been tested and validated through conversations with Carbon Co-op, who stated the most important components that a standard would need to have to be accepted by their organisation would include:

- "Components that could enable the provider to access additional sources of finance to bring to their work. However, any strings attached to the finance should not be 'overly onerous'".

- "[Reflexive and Iterative Approach to] Standardisation – many Retrofit Providers see poor quality retrofits coming out of [standardised approaches], so are sceptical of how these standards and frameworks deliver the proper retrofit in real life."
- "Standardised processes for collecting data may be [sufficient] – [these processes] would make things quicker, but there is a limit to efficiency they would see."
- Acceptance from a range of actors including those mentioned under 'industry acceptance' in the table above.

Now that the need for, and key components of, an industry-accepted MES standard have been described, this report will look at the further requirements for the adoption of MES approaches, operating under the assumption that a well-defined MES standard will be established and accepted by key stakeholders (as listed above), ready for market adoption.

The need for capacity building to support MES adoption

What do we mean by capacity building?

Capacity building aims to improve the capability to "produce, perform or deploy" new or pre-existing tools, techniques and business models (inter alia) at an organisational or individual level. Within our target context of the UK's retrofit ecosystem, this capacity building relates to a range of actors and their ability to adopt and deploy MES methods.

This ability will be derived from diverse factors, such as levels of staffing, their expertise and specialisms, availability of financial resources and expertise, availability of downstream contractors and upstream supply chains/funding streams etc.

Why is capacity building required?

Capacity building is required for the adoption and upscaling of the RetroMeter business model because MES methods have not achieved industry acceptance within the UK. There are many elements of MES methodologies that are novel or not current practice amongst the actors of the UK retrofit ecosystem.

A. **Input Data Requirements** – The targeting, baselining and ongoing performance measurement of household energy consumption requires much deeper input data requirements, covering elements such as housing archetype, presence of existing of planned interventions, household occupancy and pre-intervention load profiles. Many organisations may be unfamiliar with gathering such wide-reaching data, and so may need capacity to engage households, gain necessary approvals and transfer data securely, as discussed by points B and C below.
B. **Data Transfers and Privacy** – The scale of data required by MES methods makes the manual collection and transfer of data impractical or costly. As such, automated data connections and APIs are required to transfer the input data at scale. An organisation adopting the RetroMeter business model would need the capacity and skillset to establish and maintain these APIs and data connections, ensuring that the data transfers are secure and interoperable, with all privacy requirements integrated into the data structure and user interface. Whilst a Data Warehouse will assist with these components, the adopting organisation must have sufficient capacity to maintain relationships with this Data Warehouse.

C. **Household Engagement** – The RetroMeter business model envisages much longer and more comprehensive household engagement processes. This is because qualifying information will be required from households to assist with targeting and shortlisting properties to undertake retrofit, as well as due to the fact that measurement and verification procedures will have much longer run times (as discussed in point D below). To maintain political support and manage reputational risk, this household engagement will need to be carefully structured to ensure that the household understands the costs, benefits and risks of undergoing retrofit, and how these will be managed by the Retrofit Provider (see Point E, Quality Assurance, below). Whilst many Retrofit Providers undertake household engagement, the scale and specialised scheme design of the RetroMeter business model may require additional capacity building.

D. **Measurement and Verification** – The "M" in MES refers to the presence of robust measurement and verification procedures, which act as a foundation for the validation and monetisation of revenue streams and outcomes-based funding. This is the key advantage of the MES method, as actors only pay for the measurable impact that they receive. Whilst many existing retrofit models require 3 months or less of reporting on asset performance, the RetroMeter business model will require 12+ months of post-intervention data to model a full heating cycle and provide some surplus for data treatment. In addition, verifying reduced heat demand or energy cost reductions over this longer timescale can become more complex as market or household conditions change (for example, as consumers respond to price signals, occupants move home or have children etc). Some of this modelling complexity can be avoided or outsourced to the RetroMeter methodology, particularly where comparison groups of 5-25+ properties are used to normalise changing market or household conditions. This complexity will require additional capacity building, particularly for qualified individuals who can perform the necessary adjustments or assess post-intervention energy saving models. These individuals may require a form of International Performance Measurement and Verification (IPMVP) certification, further increasing the capacity building requirement.

E. **Quality Assurance** – The RetroMeter business model operates using a "pay-for-performance" concept, where many revenue streams within the value stack are dependent on the outcomes achieved by the intervention, whether this is the reduction of carbon emissions, network constraints and peak load, GP visits or customer bills. This approach is highly effective at incentivising Retrofit Providers & their upstream or downstream partners to manage the risks associated with their work. This is a unique selling point of MES approaches, but also can increase the transaction costs of retrofit due to the costs of risk management. Current actors within the UK's retrofit industry may not have the capacity required to identify, contract and mitigate these risks, and so may require capacity building to ensure their ongoing liabilities are not onerous or unsustainable, particularly where rigorous contracting is in place (as discussed in point F below).

F. **Complexity of Revenues and Contracting** – The RetroMeter business model decentralises the delivery of retrofit from purely Retrofit Providers and their downstream contractors to integrate a wider range of actors including funders, aggregators, a proposed Data Warehouse and Public Bodies. Each of these actors will have specific roles to play in terms of managing risk and funding or delivering the interventions in question, and so there is a requirement to put in place rigorous contracting to manage the complexity of MES revenues and various actor's liabilities and expected level of service. As many

existing retrofit practices do not require such complex contracting, there may be a need to build legal capacity such that organisations can tailor and maintain MES contracting structures.

How is capacity built?

The subsection above discussed how MES methods differ from current industry approaches, and why capacity building may be required to adapt to the various components of an MES offer. This section will take these market requirements and discuss the generic types of capacity building that could assist with reconciling current market approaches and MES methods. These generic types of capacity building are then associated with the relevant actors to identify the types of capacity building required across the UK's retrofit ecosystem. Whilst each actor will be responsible for deciding whether their organisation has sufficient capacity under the categories listed below, the industry-accepted standard proposed in prior sections may determine the minimum capacity required for compliant retrofit, including reference to following the PAS 2035 retrofit roles as defined by Edwards (2019): *Advisers; Assessors; Coordinators; Designers; Evaluators; and Installers*

This report refers back to the proposed RetroMeter lifecycle (Appendix 1), to determine the overarching components of an MES offer that are needed as part of an effective deployment of the business model:

1) **Internal Understanding:** The ability of an actor to understand and reconcile the value of an MES approach internally, recognising the key benefits it offers to financiers, customers and retrofit providers. This would include how MES impacts the risks actors take, the costs of set-up and deployment, risk-return profiles and how these would align with existing approaches and understanding. Most of all, there must be strong internal understanding of the benefits and limitations of an MES approach, to ensure it is deployed effectively into the UK market.
2) **Market Communication:** The ability of an actor to communicate the value of a product or service to the market, and for that value to be accepted by the market. This will involve the capability to identify the aspects that various market segments care about within the offer, and the ability to develop and deploy messages to connect the product or service to these customer concerns. In order to do this, an organisation not only needs market expertise, but also a degree of understanding of the target markets in question.
3) **Legal Applicability:** All organisations deploying the RetroMeter solution will require some legal expertise in-house to validate the underlying collaboration structure and contracting of revenues and responsibilities. This legal expertise may be centralised or distributed, but should act as an impartial, independent facilitator to assess and alleviate each party's legal risks.
4) **Risk Management Resourcing:** Offering services to the market always presents some risk, but launching or adopting a new service can reveal unforeseen or unmanaged risks. In order to enable rapid adoption, there will be a need to build the capacity of risk management resources across the market. These risks could be managed by specialist risk assessors and retrofit industry experts, but as the MES approach is novel in the UK, there is no guarantee that historic expertise will be sufficient. Another approach would be to produce a range of procedures, toolkits, techniques and

transaction enablers that could be offered to the market from a central repository to help manage and mitigate deployment risks. A proof of concept trial would be useful to identify risks and explore mitigation actions for schemes moving forwards.

5) **Client Engagement:** As well as general market engagement, there will be need for all MES Retrofit Providers to engage with, recruit and support clients throughout their MES journey. As with market communication, a degree of understanding of the different client segments is required, which may be supplemented by centralised messaging and collateral. However, unlike market communication, there is also need for a personnel resource to maintain face to face conversations and a personable user experience.
6) **Financial Resourcing and Funding:** As with any large-scale infrastructure investment, there will be a need for funding, not only for the retrofit scheme's capital expenditure and asset investments, but also to establish and adopt MES services. Some funding would also be required for centralised resources such as the proposed data warehouse, as well as for capacity building at market and organisational levels.
7) **Centralised Best Practice:** The RetroMeter solution is very flexible and adaptable to the current processes of a Retrofit Provider. However, there will be some elements of the model and industry processes that whilst they do not specify a specific implementation, do refer back to industry best practice. One example would be the approach to completion testing and the resolution of snags and installation issues. Whilst electrical installation testing is mandated under BS 7671, energy efficiency performance assessment is a recent addition (*BS 7671 - 18th edition,* 2024). This standard, and completion testing in general, represent best practice, both in terms of validating a measurement and verification approach, but also in terms of increasing client confidence.
8) **Data Expertise:** MES methods are dependent on the ongoing provision of high quality, fit-for-purpose energy consumption data. Sourcing, structuring, sufficiency testing and pre-processing these datasets can take significant expertise, and shift the project timescale from just a few months for installation and preparation testing to a few years (where existing smart meters are not available or functioning correctly) to enable 12+ months of energy data to be gathered in both baseline and reporting periods, and accurate savings estimations made. This would not be needed of course where there is existing smart meter data. Data expertise will be needed not only as APIs are established, but also to maintain data connections and resolve data concerns.
9) **Performance Measurement and Verification:** Alongside data expertise are the Performance Measurement and Verification (M&V) skills required to identify non-routine events, apply model adjustments in line with IPMVP best practice, codify savings estimations approaches, investigate underperformances and act as an independent adjudicator in cases of dispute resolution. These expertise can be quite niche, and a specific subset will likely be required for large-scale application of MES methods, which will need to emerge from market practices.
10) **Future Planning Foresight:** Many retrofit schemes are phased to provide a range of remedial or "fabric first" works to improve a building's envelope and air tightness ahead of the installation of upgraded low-carbon heating or other building energy improvements. This is logical, as installing these measures after the fact could increase the cost of the works (for example, insulating walls or roofs with solar panels present),

or could lead to inefficient asset specifications (such as an oversized heat pump in an under-insulated property). To maximise the effectiveness of MES methods, it is key to understand how building stocks are forecast to be upgraded over the coming years, to group synergistic works, ensure energy baselines are in place, and provide sufficient time for the monitoring, measurement and verification of energy savings. Connections to Public Bodies and future planning foresight will be a key component of this capacity building.

Now that an overarching view of capacity building and its specific capability components have been defined, this section can turn its focus to how best to build capacity, and who would benefit most from capacity building. Table 2 below outlines the most relevant forms of capacity building for each stakeholder in the proposed MES ecosystem:

Who needs capacity building?	Which forms of capacity building are most relevant to this stakeholder category?
Retrofit Providers (RP) / Retrofit facilitators	*Internal Understanding; Market Communication; Legal Applicability; Risk Management Resourcing; Client Engagement; Financial Resourcing and Funding; Centralised Best Practice; Data Expertise; Performance Measurement and Verification.*
Public Bodies (PB)	*Internal Understanding; Market Communication; Legal Applicability; Financial Resourcing and Funding; Future Planning Foresight.*
Network Operators (DNOs)	*Internal Understanding; Legal Applicability; Risk Management Resourcing; Financial Resourcing and Funding; Data Expertise; Performance Measurement and Verification; Future Planning Foresight.*
NHS Trust (NHS)	*Internal Understanding; Legal Applicability; Financial Resourcing and Funding; Data Expertise; Performance Measurement and Verification.*
Financial Institutions (FI)	*Internal Understanding; Legal Applicability; Risk Management Resourcing; Financial Resourcing and Funding; Centralised Best Practice; Data Expertise; Performance Measurement and Verification.*
Households/ Occupants (Oc)	*Internal Understanding; Financial Resourcing and Funding.*
Contractors (C)	*Internal Understanding; Legal Applicability; Risk Management Resourcing; Client Engagement; Centralised Best Practice.*
Data Warehouse operator (DW)	*Internal Understanding; Market Communication; Legal Applicability; Data Expertise; Performance Measurement and Verification.*
Standard Setting Body (SSB)	*Internal Understanding; Market Communication; Risk Management Resourcing; Centralised Best Practice; Data Expertise; Performance Measurement and Verification; Future Planning Foresight.*

It can be seen from Table 2 above that many forms of capacity building are shared across multiple stakeholders (such as Internal Understanding or Legal Applicability). Some of these capacity building aspects may be more effective if developed centrally, and distributed to various downstream actors. This centralised approach has numerous advantages:

- It can be more cost-effective to build a centralised resource for adoption by multiple actors to integrate or reference.
- The standardisation of centralised capacity building ensures all actors have access to the same resources, procedures and guidance.
- Centralised capacity building resources are often more static, providing the market with a sense of consistency and replicability over different timescales and geographies.

However, there are also disadvantages to the centralisation of capacity building resources:

- The standardisation of resources means that modifying the resource can require drawn out consultation processes, where the time and cost of gathering all downstream actors' feedback and acceptance is onerous.
- There will always be a trade-off between generic and specific guidance, and a centralised resource cannot both be accessible and easy to use, at the same time as covering every possible outcome. Market conditions can also change rapidly, invalidating or undermining sections of centralised guidance.
- There must be some form of entity responsible for maintaining and modifying centralised capacity building resources, which will require some form of governance and access to sustainable funding or revenue streams. Establishing this entity and its governance structure could be onerous, particularly when integrating different perspectives for the UK's energy transition and its socio-political impacts.

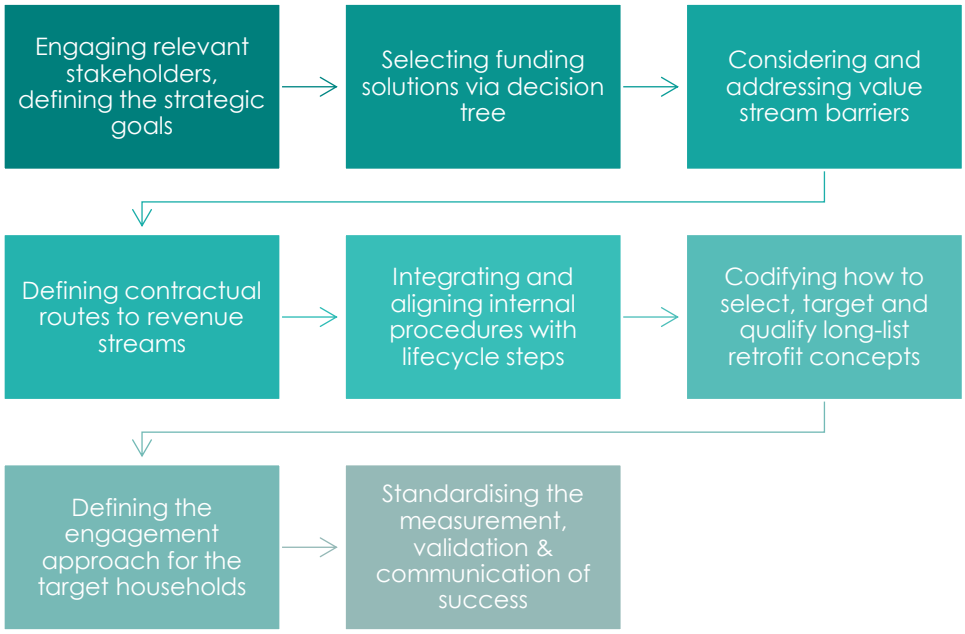
Now that the relative advantages and disadvantages of centralised capacity building have been introduced, the following sections will focus on what adoption looks like at a practical, organisational level (decentralised resourcing – "The practical approach to adoption"), as well as how centralised actors can assist with capacity building ("Supporting adoption: stakeholder contributions").

The practical approach to adoption

The prior sections have discussed the broad categories of required capacity building, how these may be associated with each stakeholder in an MES ecosystem, and why there may be advantages and disadvantages with building centralised capacity building resources.

This section will now focus on the practical pathway to adopting MES methods, taking the decentralised perspective of a Retrofit Provider to reveal the relevant capacity building actions within each activity of the pre-development lifecycle stage (shown in Figure 1 below):

The relevant activities across the pre-development lifecycle stage have been graphed in Figure 2 below:



Now that the key adoption activities for a Retrofit Provider have been defined, each can be examined in turn, as shown below. This work leverages conversations with Carbon Co-op held on the 7th March 2024 to validate the proposed activities and adoption requirements.

Carbon Co-op Comments	Proposed Implementation
Activity: Engaging relevant stakeholders, defining the strategic goals	
• Stakeholder engagements should establish access to pre-existing household energy consumption data wherever possible to avoid the many barriers to get smart meter data. • The role of the local authority is key in securing necessary approvals for planning consent and other licenses under their remit.	• Stakeholder engagement should integrate the following actors: local authorities (Public Bodies); other Retrofit Providers; Relevant Public Body governance structures (i.e. social housing boards); Householders and Neighbourhood Groups (Occupants). • The definition of strategic goals should be used to leverage and justify applications and approvals from local planning committees, regulatory bodies and the

• The focus of stakeholder engagements should integrate the pathway to get approvals from relevant boards, regulations and licensing bodies. • It is key to engage with householders cohesively – there are a lot of people a retrofit provider needs to manage to ensure retrofits happen on time. • Alongside localised actors, another key stakeholder group are other retrofit providers who are currently delivering high-quality retrofits. These actors can give confidence to similar organisations to participate, providing expertise and exposure to the realities of delivering large-scale retrofit.	boards of Public Bodies such as social housing providers. • Stakeholder engagement should occur at the earliest opportunity and be iterative throughout the scheme's deployment.
Activity: Selecting funding solutions via decision tree	
• The key thing raised for the standardisation of MES offers was the extent to which it could enable the retrofit provider to access additional finance stream to bring to their work.	• A standardised process for assessing the viability of revenue streams has been established (see Appendix 2). • It would be valuable to create a procedure for determining value stream viability thresholds as part of the ongoing/iterative stakeholder engagement, such that each scheme design can be assessed by the Retrofit Provider against established thresholds.
Activity: Considering and addressing value stream barriers	
• The assessment of value streams and set-up processes currently requests a lot of data points or requires a lot of admin. Carbon Coop stated this would require significant resourcing from a Retrofit Provider, and therefore may deter them.	• An adoption procedure may specify how or where to source this data from, lowering transaction costs. Some data points can be sourced from the setting of strategic goals. • A central entity could provide a set of standardised assumptions that could be reviewed, challenged and adapted by local experts. • Indicative costs and activities could be provided for value streams, enabling rapid cost-benefit assessment of individual revenue streams.
Activity: Defining contractual routes to revenue streams	
• Carbon Co-op stated that "whatever strings [are] attached to the finance [should not be] overly onerous." • Carbon Co-op stated that whilst the contractual approaches of publicly-funded schemes may be useful, that care should be take, as many retrofits that been delivered through public procurement schemes have not been high quality. This is an indicator that use of a standard like PAS2035 or employing an installer who has certain accreditations is by itself no guarantee of high quality works.	• The complexity of establishing revenue streams should be phased to reduce the development costs prior to the point that the revenue stream is proven to be financially self-sustaining (integrating administrative costs). • The contractual obligations of accessing finance should be standardised or structured consistently wherever possible to ensure the cost of deploying finance is not "overly onerous". • Whilst the contractual frameworks of publicly procured schemes may represent a good starting point, they are not bulletproof. An MES-specialised contractual framework may be needed to ensure sufficient quality assurance.
Activity: Integrating and aligning internal procedures with lifecycle steps	
• There are lower cost ways of getting internal temperature data. Currently there are £300 of sensors going in for Carbon Co-op's	• Pre-existing monitoring and measurement approaches should be integrated into the scheme design wherever available and

scheme but these capture more than just temperature, and can be much lower cost (such as battery operated data loggers). • Data might be of variable quality depending on the technical approach/specification, and may be impacted by behavioural factors (such as occupants modifying or tampering with equipment)	effective. This is particularly true where a low transaction cost method has already been developed. • Data sufficiency tests should be standardised and aligned with the guidance from the Standard Setting Body to ensure appropriate data quality. Contingency plans should be established to manage data insufficiencies.
Activity: Codifying how to select, target and qualify long-list retrofit concepts	
• Carbon Co-op highlighted that smart meter penetration levels are hovering at only 50% of householders. It is known that smart meter adoption is a bigger barrier for some communities than others as there is "lots of distrust of them". • As retrofits are optional, the selection process can be drawn out with no commitment for a retrofit to be completed. • When targeting households, many Retrofit Providers are unaware of which households have smart meters installed in them. This may be exacerbated where the owner and occupant are different parties, as in tenanted settings metering and billing arrangements are usually the tenant's remit.	• Neighbourhood-scale smart meter rollouts may be required as preliminary works for areas expected to undergo retrofit in the coming years (i.e. due to localised network constraints). These rollouts should be specialised to build trust and install smart meters in communities that have historically been underserved. • The qualification of retrofit recipients should be targeted to ensure that light touch engagements build up to an ongoing commitment at low transaction costs. • Data on smart meter coverage for social housing providers should be made more transparent as retrofit schemes are conceptualised.
Activity: Defining the engagement approach for the target households	
• Carbon Co-op stated that "Access to properties can be a huge challenge in some settings". These settings include examples such as a housing provider looking to secure access to a tenanted home to complete a survey/retrofit assessment. • Carbon Co-op also stated the issues with accessing household data remotely across all communities and settings, for a range of reasons – "Even if you are just sending sensors out in the post – this could be very challenging in some communities. "	• There is a need to identify and address the risks and barriers to accessing properties for retrofit engagements. This could be an example of centralised guidance for Retrofit Providers. • It is key to understand in any engagement approach how various communities, and their institutional trust, differ.
Activity: Standardising the measurement, validation & communication of success	
• Carbon Co-op's current measurement and verification approach (for the current area-based scheme) is to: o Send a survey one year post-works (likely sent by Carbon Co-op) o in-depth qualitative evaluation (conducted by a third party evaluator) o In addition, Carbon Co-op are implementing a reconsent process through their PowerShaper Monitor smart meter platform. This would reduce the need to chase households unless a householder didn't action the reconsent. o It is key to highlight that outsourcing will not necessarily reveal the necessary information, as Carbon Co-op's evaluation integrates broader aspects than just energy use. Additionally, if there is a separate entity trying to engage households on data gathering, there is an additional step to introduce this	• A standardised approach to performance measurement and verification could be adapted from (International Performance Measurement and Verification Protocol) IPMVP best guidance for adoption by either Retrofit Providers, Aggregators or their third-party representatives. • There may be a requirement for educational and transitional support for Retrofit Providers currently operating a PAS2035-compliant approach, which only requires a basic follow-up survey 3 months after the completion of works. • The costs of software-based solutions should be integrated into the overall cost benefit assessment of revenue streams when a retrofit scheme is first established. A centralised entity may be able to negotiate a standardised pricing and onboarding model to support MES approaches at scale, as proven through the ReCurve model in the US. • The role of the data warehouse should be codified in terms of providing Retrofit

entity and build householder trust/understanding in their activities. • Carbon Co-op stated that "Many providers don't currently collect any data. Standard practice for PAS2035 is basic survey 3 months after works finish". The PAS2035 evaluation is a relatively basic occupancy survey/questionnaire. Whilst retrofit assessments are encouraged to include real occupancy data, and this occurs in some cases, it is not mandated but integrated "where available". Other Retrofit Providers and stakeholders have fed back that this often doesn't happen due to the time pressures these actors are under to complete surveys. • When exploring alternate approaches, Carbon Co-op stated that "Some are putting in Switchee systems but for handful of homes – might do a sample but not all of them. Because of costs. There's ongoing costs associated with it from a software side – council probably need to buy 3-year software services agreement with Switchee."	Providers and Aggregators with ongoing access to primary data or measurement and verification analytics. This will include secure APIs to existing industry solutions such as Switchee or other in-home devices. • The communication of success could be supported by centralised marketing collateral and market engagements (i.e. such as specialised technical conferences). These elements will be discussed further in Section 3: Upscaling the RetroMeter Business Model.

Table 3, above, has described what adoption would mean in practice for each activity within the pre-development stage of the proposed MES lifecycle. However, it is expected that the implementation of capacity building activities will be iteratively reviewed as Retrofit Providers "learn by doing". This will require a robust mechanism for providing feedback and resolving adoption snags over the course of a few pilot schemes covering different types of buildings and retrofits across the UK.

This mechanism may require some central entity or central support to manage the consultation and piloting process. The following section will examine the various forms of centralised/stakeholder support that will assist with the adoption of the RetroMeter business model.

Supporting adoption: stakeholder contributions

This section will examine how various stakeholders can support the capacity building discussed in prior sections. There are a range of stakeholders relevant to this capacity building, but this section shall focus on the following examples, inter alia:

1. DESNZ: The Department for Energy Security and Net Zero (DESNZ) could support the adoption of the MES approach by supporting conversations with the British Standards Institute (BSI) and the Data Communication Company (DCC), as well as local DNOs, Public Bodies, social housing providers and national Retrofit Providers. In addition, the DESNZ could assist with funding centralised resources such as the Data Warehouse or standardised capacity building documentation.
2. DCC / Data Warehouse: The DCC and proposed MES Data Warehouse could assist the adoption of MES methods by establishing standardised data access protocols and low-transaction-cost secure APIs to provide Retrofit Providers with the high-

granularity energy consumption data and relevant consents to enable the measurement and verification of MES.

3. Facilitators and pilot schemes: Pilot schemes and facilitators can provide transparent access to the successful and less successful attributes of their schemes, enabling reputational risk to be mitigated, underperforming designs to be avoided and successful approaches to be replicated. These pilot schemes can also build data connections, stakeholder relationships and investment pipelines to lower the cost of replication and attract further piloting, adoption and upscaling of the MES approach.
4. DNOs: DNOs can assist by helping to connect their flexibility tenders to MES services and their measurement and verification approach. This could include the establishment of standardised contracts, qualification processes prior to tendering or development of a technical assistance function to help MES Retrofit Providers align their scheme design with network revenue streams.
5. Academia: Academics could assist with the review and revision of messages to engage and build trust with underserved communities, providing socioeconomic analysis and insight. In addition, academics can assist with the evaluation of MES retrofit schemes, helping to communicate success and the attributes that support this success for ongoing replication across the UK's retrofit industry. In addition, academics could assist with potential routes to access datasets like the Smart Energy Research Laboratory (SERL) for comparison group development.

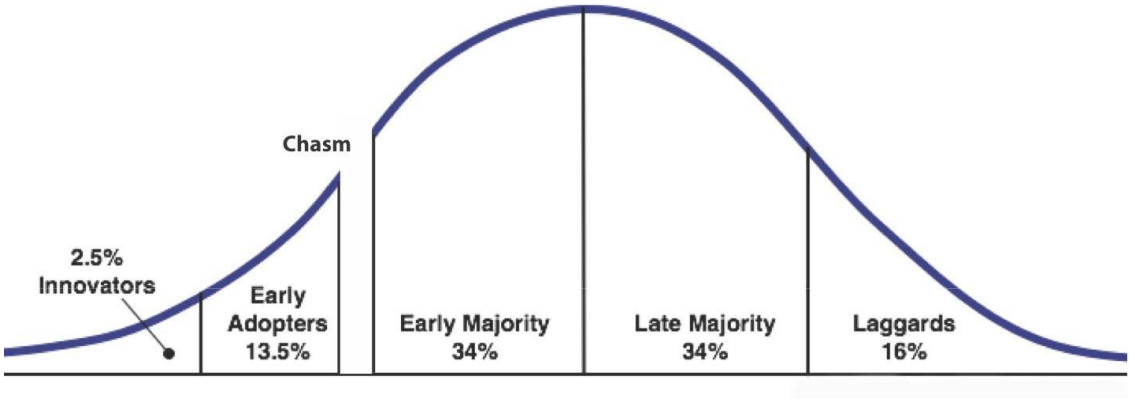
This section has discussed the requirements for adopting an MES approach to domestic retrofit, assuming an industry-accepted standard and specific capacity building activities. This section has established some proposed implementations and recommendations for Retrofit Providers to adopt the RetroMeter business model as they complete their pre-development lifecycle activities. In addition, this section concludes with proposals for how various actors can support the adoption of MES methods at scale. This latter topic will be discussed further in the following section: "Upscaling the RetroMeter Business Model".

Section 3: Upscaling the RetroMeter Business Model

This section will explore how retrofit facilitators or one-stop-shops can scale-up the RetroMeter Business Model, ultimately leading to the delivery of MES-enabled retrofits at a larger scale. This section flows chronologically from the previous and will assume that retrofit facilitators will have already adopted the RetroMeter Business Model prior to upscaling it.

The Adoption Chasm - Barriers to Scaling up

Before exploring the specific factors needed to upscale the RetroMeter Business Model, it is pertinent to understand how, why and at what rate new ideas become accepted and used by a group or population. The Chasm Theory explains this the 5 Stages of Adoption in Figure 3 below (Diffusion Research Institute, 2023):



In this theory, the adoption curve is a bell curve model that describes how different people react to new innovative ideas. Each category of adopter will have different motivators when adopting new technologies or ideas as shown in Table 4 below:

Adopter	Description
Innovators	• These are 2.5% of the population. • They are willing to take risks and love trying new things. • They like going against the grain and are rarely concerned with failure. • They are often the initiators of change. • They are often motivated by exciting opportunities that the idea presents.
Early Adopters	• They are 13.5% of the population. • They are trend-setters and tend to be comfortable taking risks. • They love being the first to know about new ideas but need to form a solid opinion before they vocally support it. • They are more concerned about reputation and are not comfortable failing publicly, like innovators are. • They are often motivated by guides and training on how to use the ideas.

Early Majority	• These are 34% of the population. • They are interested in new ideas but want proof of its effectiveness. • They often need case studies and real-life stories to believe in the idea. • There is often an adoption chasm from early adopters to early majority as a more pragmatic approach is required to convince them of what the idea can accomplish. In order to approach them, data-driven arguments need to be made.
Late Majority	• These are 34% of the population. • Much like the early majority, the late majority want data-driven reason to adopt the idea. • They do not like to take risks and often question the need for changes. • They are not easily persuaded by trends and prefer to see how the changes play out before getting involved. • They are motivated by solid proof that the idea works in real life. Innovators and early adopters are often used to show how the idea is effective.
Laggards	• These are 16% of the population. • They are often very wary of new ideas and need answers around 'what is in it for them?' • They prefer the status quo as they know what to expect. • They are quick to give up on ideas that do not immediately make things more efficient for them. • They are motivated by the success stories around the idea.

In order to transition from early adopters to mass adoption, the majority of ideas will need to overcome the critical challenge of crossing the 'adoption chasm.' This refers to the significant gap or challenge between addressing a customer segment that is typically more open to innovation and comfortable with risk (early adopters) to a customer segment that is more risk-adverse and resistant to change. In the case of RetroMeter, crossing the 'adoption chasm' applies to two distinct customer segments:

<u>The Funders:</u>

Early Adopter

These could be Angel Investors or Green Lenders

Angel investors play a crucial role in supporting new business ideas and innovative business models, whilst green lenders like to invest in ideas that reduce carbon off their loan books.

They are often willing to take higher risks in exchange for significant returns on their investment and prefer more hands-on involvement in the business idea, providing mentorship, guidance, and networking opportunities.

They are more committed to the long-term success of the idea and driven by their desire to be a part of ground-breaking and impactful projects.

Early Majority

These could be outcome-based investors who seek investments that contribute to positive change.

When speaking about residential retrofits, this could be a local authority that wants to reduce fuel poverty or heating-related emissions in their place, or an NHS Trust looking to reduce the number of patients visiting their local clinics due to cold-home related illnesses.

Whilst these institutions may be more likely to invest in projects that positively influence the public's perception of them, they are also extremely risk adverse and will often need proof of the impacts or benefits that they are being offered through the projects.

Late Majority

These could be mortgage lenders, venture capitalists or commercial banks.

These funders usually only invest in business ideas that have high growth potential, some market traction and low risk.

They need to be shown compelling evidence that the business idea works and can offer quick and high returns on investment.

These funders will likely expect near-term exits, and typically seek evidence of a scalable business model, sizable market and validated customer demand.

The Householders:

Early Adopter

These are householders that are likely interested in getting retrofits done and are aware about the benefits those retrofits can offer them, such as a warmer house, reduced energy bills or a reduction in their emissions. They may likely already be a member of a retrofit facilitator's mailing list.

These individuals are often also tech-savvy and may be eager to implement smart building systems or energy management software in their homes.

With the right guidance, these householders are likely to gain confidence and participate in MES-enabled retrofit schemes.

Early Majority

These householders are probably interested in sustainability and want to understand more about the different options available to them.

They would have likely heard about retrofit schemes through word-of-mouth, social media or direct marketing, but are quite skeptical of the benefits. The credibility of the retrofit facilitators may build their confidence in the project, but they will still need data-driven arguments to convince them to participate.

These householders will likely have a mixed penetration of smart meters, with varying degrees of skepticism around data sharing.

Late Majority

These are the householders that need to see tangible benefits and a track record of success in similar households.

These householders are less motivated by environmental concerns and more by practical considerations such as reduced energy bills, improvements in comfort and / or increase in property value.

These householders will have very little trust in smart meter technology and providing access to their homes. They likely value their privacy prefer to be complacent with the way they live.

Retrofit facilitators face various barriers that hinder the widespread adoption and implementation of residential retrofits. These barriers include:

1. **Lack of trust in smart meter technology**: Currently only around 50% of residential homes have a smart meter across Great Britain. As of now, there are no legal requirements to install smart meters in residential homes and while the uptake of smart meters among the general population has been increasing steadily, householders still have a lot of distrust in them. Without smart meter data, the MES methodologies begin to lose accuracy, leading to reduced confidence and credibility in the RetroMeter business model.
2. **Access to smart meter data**: Householders tend to understand the value of personal data; However, many are disempowered by the lack of transparency around how companies use and share data, and often experience information asymmetries and cognitive limitations around the legal verbiage in data sharing policies. Householders also tend to be wary of the privacy concerns associated with data sharing, all of which affects their willingness to participate in activities that involve doing so. In addition to these factors, there are also practical challenges that limit access to consumption data. These include: smart meters that don't work; lack of an In Home Display; and older meters that don't function in smart mode. These challenges result in many retrofit facilitators being unable to collect any consumption data pre-retrofits, thus limiting the measurement and verification of the benefits from the retrofits.
3. **Low data quality**: Even in the houses with smart meters, electricity data can range from low to high quality, with many homes missing key data points within the required 12-month period pre-retrofit for the MES methodology. This, in turn, affects the accuracy of the MES methodology in predicting the energy savings from the retrofit, thus, reducing the credibility of the model and the stakeholders endorsing it.
4. **Limited technical expertise**: Many retrofit facilitators and one stop shops work with actors in the supply chain that are often smaller enterprises and do not hold formal accreditations like PAS2030 and TrustMark, as the costs and time required for accreditation are prohibitive. Retrofit facilitators recognise that lack of accreditation is not an indicator of lack of quality, however the standardisation of frameworks within the RetroMeter business model may mean that contractors lacking the required accreditations may not be eligible to participate in the model and associated retrofit schemes. Consequently, this would reduce the overall number of experienced contractors that could participate, and thus, restrict the upscaling of the model.
5. **Split Incentives:** Split incentives occur when the costs and benefits of retrofits are not aligned between landlords and tenants or between sellers and buyers of properties. For example, landlords may be responsible for financing and implementing retrofits, but tenants receive the benefits in the form of reduced energy bills. This mismatch of incentives can lead to underinvestment in retrofit projects.
6. **Disruption and inconvenience:** Retrofitting projects can be disruptive and inconvenient for homeowners, requiring them to temporarily vacate their homes or endure construction work and disruptions to their daily routines. Concerns about inconvenience or the perceived hassle of retrofitting may deter homeowners from pursuing retrofit projects, even if they recognize the potential benefits.

7. **Regulatory and policy barriers:** Regulatory barriers, such as complex permitting processes, building codes, zoning regulations, comprehensive data sharing agreements, and restrictions on building modifications can impede retrofit efforts. Additionally, inconsistent, or unclear, policies related to incentives, rebates, or tax credits for retrofit projects may create uncertainty and deter homeowners from taking action.
8. **Lack of trust in the finance model:** It is unlikely that investors would want to invest in retrofits that have a history of underperformance. Although actual performance risk may be passed onto contractors and suppliers contractually, and therefore on paper the financial institutions is not taking performance risk, in reality they are taking reputation risk. The risk of perceived mis-selling is high given the history of mis-selling scandals. Where finances are bundled, funders tend to be sceptical of the funding mechanism and structure, as well as the quality assurance and risk allocation of the projects. Private investors will also need to conduct due diligence on the fund, as well as evaluating the credit risk, aftercare, and safety checks, which can be onerous when projects are not standardised and aggregated to achieve attractive paybacks. This leads to a lack of access to financing options for retrofit projects, which, when combined with high upfront capital costs, is a barrier to upscaling MES-enabled retrofits.

Whilst many of these barriers relate directly to the householders receiving the retrofits, without householder confidence, it will be difficult to deliver large scale retrofit pilot schemes that can be used to measure and verify the benefits of MES-enabled retrofits, thus deterring funders from wanting to invest in the model. Therefore, highlighting these barriers aims to tackle the requirements of both early and late majority funders and householders, which are both driven by the need for tangible evidence and actuarial data.

Factors that have led to MES success elsewhere.

Now that we have explored the barriers to widespread adoption and implementation of the RetroMeter business model, we will look at the factors that have led to the successful adoption of MES methodologies and business models in the United States:

- **Uptake of smart meters**: Utilities across the U.S are deploying smart meter infrastructure. With more smart meter data available, the possibilities of using metered data to verify energy savings have expanded.
- **Regulatory support**: Regulatory frameworks at the federal, state, and local levels have played a crucial role in mandating metered energy savings approaches for energy efficiency programmes. For example, the Assembly Bill 802 in California calls for programmes aimed to increase the energy efficiency of existing buildings to take into consideration the overall reduction in normalized metered energy consumption as a measure of energy savings (Lipscomb, B. 2018). Incentives, rebates and tax credits, and energy efficiency mandates incentivize the adoption of energy-saving measures and encourage the use of performance-based contracting models. Moreover, regulations have increased utilities' obligations to deliver energy efficiency.
- **Technological advancements:** Advances in sensor technology, data analytics, and building automation systems have improved the accuracy and reliability of energy

monitoring and measurement. These technological advancements enhance the effectiveness of metered energy savings methodologies and enable more precise targeting of energy efficiency interventions.

- **Industry standards and guidelines:** The development of industry standards, guidelines, and protocols for energy measurement and verification (EM&V) ensures consistency and reliability in energy savings calculations. Adherence to recognized standards enhances credibility and facilitates market acceptance of metered energy savings methodologies.
- **Risk transfer:** Metered energy savings models often involve some form of risk transfer, where the responsibility for achieving energy savings and maintaining performance is shifted from the building owner to the ESCO or contractor. This can provide financial security for building owners and investors, as they are not responsible for upfront costs or performance risks.
- **Financing options:** Various financing mechanisms, such as energy performance contracts (EPCs), on-bill financing, Pay-for-Performance (P4P) models and third-party financing facilitate the implementation of metered energy savings projects. These financing options help overcome upfront cost barriers and enable building owners to invest in energy efficiency upgrades with little to no capital expenditure.

These are just some of the various factors that have led to the success of metered energy savings approaches in the United States and have collectively contributed to the widespread adoption of energy efficiency retrofits in buildings. These factors will provide a framework for the scale-up plan needed to engage with various stakeholders and cross the 'adoption chasm' for the Retrometer business model.

Factors required to Scale Up

Having explored the barriers to mass adoption and the factors leading to MES success in the United States, this section aims to explore the key factors required to scale up the Retrometer business model in the United Kingdom, leading to the creation of some key recommendations that will enforce the wider scale-up plan.

It is important to note that while retrofit facilitators will be key actors in engaging with stakeholders at a local level, it will be the central entity, or Aggregator, that will be required to produce the guidance that can be implemented and localised by several place-based Retrofit facilitators in their roster.

The Aggregator will need to equip the facilitators with the marketing collateral and engagement approach needed to ensure large scale aggregation of MES-enabled retrofit projects at a national level. This is because the Aggregator will ultimately be the entity responsible for managing the MES Fund required to finance the retrofits, and therefore, in collaboration with the retrofit facilitator, the Aggregator will need to take into consideration the requirements of two distinct customer segments: **The Funders** and **The Householders**.

Regional Approaches

This section will start by focusing on some of the recommended approaches retrofit facilitators can take to tackle some of the barriers presented in the section above, with a

view to increase widespread adoption of the Retrometer business model within their own region:

Short Term (1-2 years):

- **Training the supply chain**: Retrofit facilitators may be required to support local, smaller contractors in obtaining the appropriate accreditations if these are required by the investment guidelines of the MES Fund. This may involve upskilling their staff and building systems where smaller contractors can participate in large-scale retrofit schemes under the safety net of larger contractors.
- **Building trust around smart meters and data sharing**: As retrofit facilitators move from targeting early adopters to the early majority of householders, in order to overcome scepticism around smart meter and data sharing, they will need to work together with their current data repository owners / managers to:
    - Provide householders with the option to choose varying degrees of anonymization capabilities;
    - Ensure they are storing the data securely;
    - And deleting the data after use.

  In addition to the above, retrofit facilitators will need to change the way they engage with and communicate the benefits of smart meters to householders. Some of the key steps to increase smart meter uptake through marketing would be to:
    i. Reassure householders that the amount of data they store is to a minimum;
    ii. Increase transparency about the information collected, how it be used and whether it will be passed onto a third party;
    iii. Proactively provide clear, consistent, and easy-to-understand information about the implications from consenting to provide personal data;
    iv. And give participants the ability to opt out of sharing their data when they want to.

Medium Term (2-5 years):

- **Collecting better quality data**:
    i. Retrofit facilitators should engage with relevant policy makers and stakeholders, such as the DCC, to prompt the development of automated systems that can inform householders when their meters are faulty and require repairs, thus reducing the amount of bad quality data.
    ii. In addition to this, retrofit facilitators will need to engage with technology providers to gauge their interest in participating in portfolio monitoring services. High interest could lead to selectivity in the type of monitoring equipment being installed, ensuring high quality smart meter penetration into the residential market.
- **Developing operational scalability**: Retrofit facilitators must be prepared to handle increased demand, streamline production processes, and enhance householder support capabilities. This may involve expanding their distribution channels, optimizing their supply chains, investing in technology infrastructure, and elongating their involvement with the householders as the Retrometer business model requires engagement with Measurement and Verification (M&V) specialists to measure and

verify the impact of the retrofit and thus, unlock the different value streams. Implementing householder feedback loops and addressing concerns promptly will also foster a positive reputation, unlocking more opportunities to engage with the wider market.

- **Unique marketing and communication**: retrofit facilitators must ensure that the business model addresses the broader needs and preferences of the mainstream audience and reflects on the added value delivered by the MES methodology. Retrofit facilitators may be required to adopt their value propositions to align with the incentives of different stakeholders, after which they must effectively communicate the value of the model, often requiring a shift in their marketing strategies and messaging.
    i. One such example would be around tackling the barrier of split incentives, which retrofit facilitators can do by communicating the benefits of MES-enabled retrofits to the tenants (verified reductions in energy bills, measurable comfort increases in homes), the landlords (EPC uplifts and validated increases to rental value) and the funders seeking to reduce the carbon intensity of their loan books. The use of personalised marketing strategies, such as stakeholder engagement initiatives, workshops, roundtable discussions, and public awareness campaigns, in combination with different marketing medias such as social media, email, event, and word of mouth, will foster dialogue and consensus-building around MES implementation strategies.

Long Term (5-10 years):

- **Establishing credibility:** Specifically, the aggregator and its roster of retrofit facilitators must look to build the trust of both the institutional organisations that may look to fund the retrofits through the MES Fund, as well as the householders willing to participate in the scheme. This should be done through pilot programmes and demonstration projects, historical data, householder testimonials and M&V reports that ultimately validate the positive impacts and financial returns from those retrofits, thus building momentum for wider adoption. A key component in ensuring actuarial evidence data around those retrofits is collected in the Data warehouse, a data repository that aims to store data, assess project performance, develop exemplar cases and provide consumer-facing data access. As more pilot programmes are delivered, this data repository will need to be developed and an iterative process to collecting and building actuarial data sets will need to be taken prior to introducing the business model to the wider public. Carbon Co-op have highlighted the possible next steps to inform future phases of the current Area Based Scheme in Levenshulme in the WP4 report.

While this list highlights some of key approaches to upscaling the business model within the retrofit facilitator's region, it does not encompass the political and regulatory landscape that will be a key step to scaling the idea up at a national level.

National Approaches

The following section examines current government schemes aimed at improving the energy efficiency of residential homes and explores the way in which this market sector can be leveraged to promote the Retrometer business model.

Table 5 summarises the current government schemes in the UK aimed at improving energy efficiency of residential homes and ways to incorporate MES methodologies into these schemes to prompt uptake of the RetroMeter business model:

Scheme	Area	Description	RetroMeter Implications
Energy Company Obligation (ECO)	Great Britain	• This is a government energy efficiency scheme designed to tackle fuel poverty and help reduce carbon emissions. (Ofgem, n.d.) • The scheme requires medium and large energy suppliers to promote energy efficiency measures in low-income and vulnerable households, as well as those living in harder-to-treat properties. • Under this scheme, eligible households may receive funding for measures such as insulation, heating upgrades, and draught-proofing. • A total of 323,408 measures have been submitted to Ofgem under ECO4, which are predominantly aimed at upgrading boilers, installing heating controls and installing loft insulation.	• It is up to the energy suppliers to determine what energy efficiency measures they want to fund and the level of funding they will provide. In some cases, householder contributions may be needed. • Currently, the evaluations are based on number of measures supported by deemed savings rather than actual savings. • MES methodologies could enable suppliers to measure the actual energy savings from specific energy efficiency measures for a portfolio of homes more accurately. This would allow suppliers to tailor the measures to the usage patterns of those homes, optimising the energy savings whilst prompting the implementation of more performance-based contracts through energy service companies (ESCOs), thus increasing the scale of energy efficiency measures being delivered. • Overall, RetroMeter could offer the potential for a more robust, outcomes-drive energy efficiency programme, without the need to install a lot of expensive monitoring kit. In order to do so, the Aggregator will need to engage with Ofgem to determine their intent on whether energy suppliers will be required to report on metered energy savings for selected ECO interventions. • It should be noted that this scheme cannot be blended with funding

			from other government schemes or grants. Therefore, in order to increase the scale of whole house retrofits, blended public and private finance models may be required. • It should also be noted the deemed savings approach tends to be more generous than actual, which may result in supply chain resistance when incorporating MES methods into ECO.
Social Housing Decarbonisation Fund (SHDF)	England	• This fund is used to upgrade the social housing stock currently below Energy Performance Certificate (EPC) band C, up to that standard. • The fund allocates up to £80 million to support the installation of energy performance measures in social homes in England. • More details on this scheme can be found in Carbon Co-op WP4 Deliverable 3 Report.	• This has been discussed as a route to a large-scale MES pilot project but has numerous stakeholders and moving parts with restrictive timescales. • For MES to be integrated, Carbon Co-op have said that significant effort is needed to go into the early-stage planning of projects and the installation of smart meters is a vital pre-requisite of an MES enabled retrofit • MES could play a role in evidencing whether reductions in energy use have been realized, as part of the monitoring and evaluation within PAS2035, or flagging the need for further investigation if the savings are less than anticipated. See Carbon Co-op's WP4 D3 report for more details.
Home Upgrade Grant (HUG)	England	• This grant funds energy saving improvements for homeowners in England that are not using gas boilers as their main heating system and have an EPC rating below C (GOV.UK, n.d.). • If eligible, the local council arranges a home survey to see how the home could be made more energy efficient. • Improvements that could be funded include wall, loft and underfloor insulation,	• Data from MES methodologies could be used alongside the home surveys to provide local councils with a better understanding of the types of measures to implement in a portfolio of houses, as well as the quantification of the energy savings from those measures. • Post retrofit, the methodologies could play a role in evidencing the reduction of energy usage from the measures installed. • However, the MES methodology is only really accurate when a number of homes are combined, therefore, could not be used on an individual household basis.

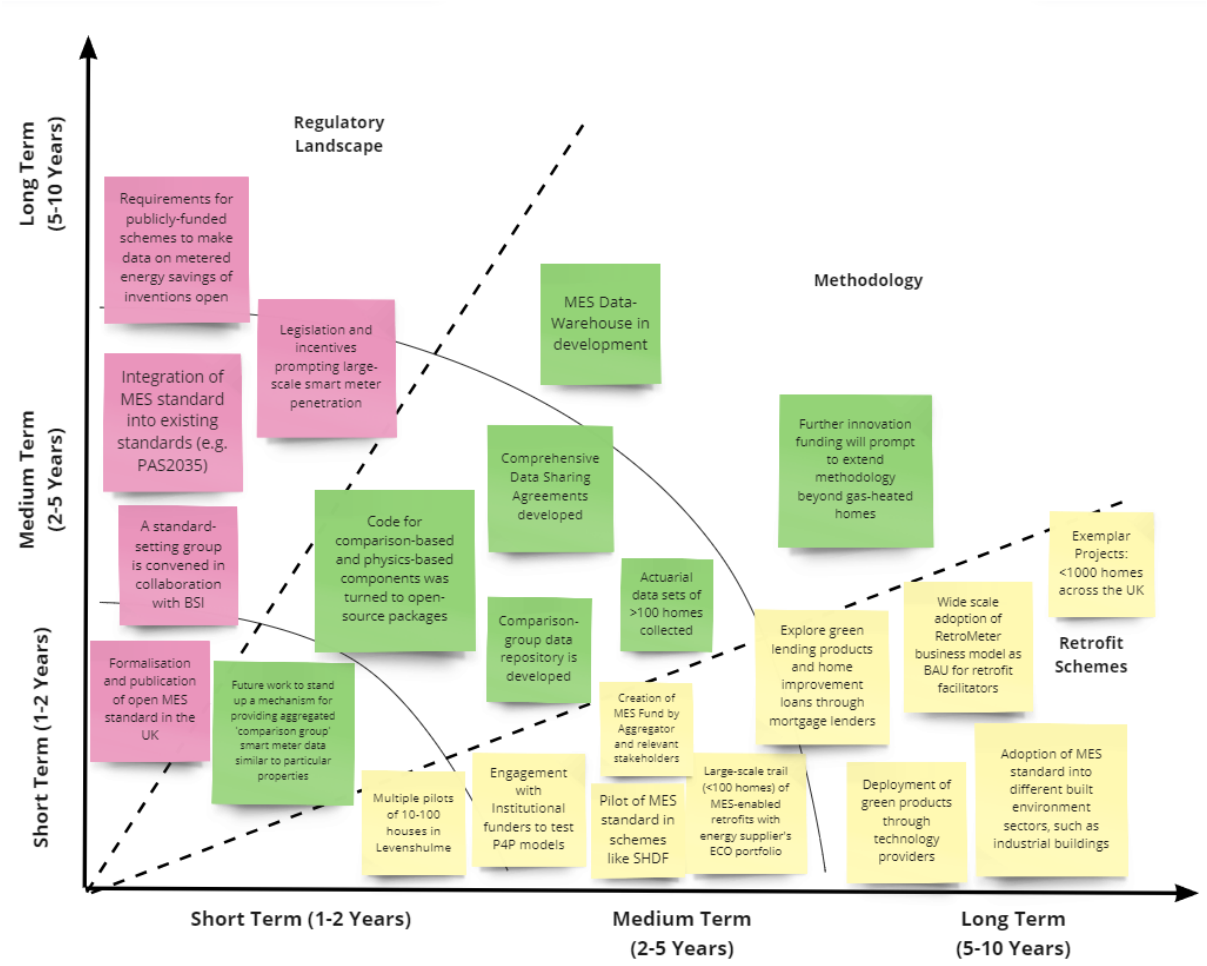
		air source heat pumps and electric radiators.	
Green Homes Grant Local Authority Delivery scheme (LAD)	England	• £500 million of funding has been allocated to improve the energy efficiency of homes of low-income households, helping reduce fuel poverty, phasing out high carbon fossil fuel heating, and delivering progress towards the UK's commitment to net zero by 2050 (Department for Energy Security and Net Zero, 2022). • Phase 2 of the LAD Scheme allocated £300 million between 5 Local Net Zero Hubs, who are regional points of expertise and coordination on energy issues.	• Similar to the SHDF, this scheme could be used to pilot a large-scale MES retrofit project, but will likely have various stakeholders and decision makers involved. • The LAD scheme could be used as a way to support data collection efforts by providing access to energy usage data, building characteristics, and retrofit project information, which are essential inputs for conducting energy savings assessments. • Through MES, the local councils participating in the LAD scheme may also adopt performance-based contracts with contractors or energy service companies (ESCOs) to deliver energy efficiency improvements. This will incentivize contractors to achieve specified energy savings targets, lead to an increase in the quality of local energy projects

For each of these schemes, it is important to note that a vital component to unlocking the Retrometer business model and utilising MES methodologies is the presence of smart meters with 12 months of historic energy usage data in the target homes. This is because without smart meter data, the MES methodologies investigated in the Alpha Phase of the SIF-funded Retrometer project were discovered to be too inaccurate for wide-scale adoption and funding. Approaches to increase smart meter penetration in households through householder engagement and marketing have been discussed in the regional approaches through the retrofit facilitators, however, penetration at a national level will require:

- Stronger levers around smart meter roll-out. New regulatory frameworks and subsidies may also need to be implemented to incentivise householders to share their energy usage data once they have installed smart meters, as well as encourage them to invest in energy efficiency measures. Streamlined regulatory processes and standards for MES implementation can help reduce barriers and promote consistency across the industry, enabling pre-conditions to upscaling the Retrometer business model.
- Regulatory and technical mechanisms to eliminate common causes of smart meter data quality issues.

Recommendations for the Scale Up Plan

The following diagram summarises the key steps that are needed in order to scale the RetroMeter business model up in the UK, with a focus on the methodology, the regulatory landscape and the retrofit schemes.



In this diagram, the Short Term, Medium Term and Long-Term sections correspond to the early adopter, early majority and late majority stages of adoption and highlight the need for a phased approach to upscaling, starting from a local level to a national level.

The diagram consolidates the following recommendations to adoption and upscaling. These recommendations are presented in an approximately chronological order, and have been categorised by their time horizon.

1-2 Year Time Horizon

1. **Standard-setting and Integration**: The significance of a centralised standard, and standard-setting body in convening and promoting MES schemes has been highlighted throughout this work. The MES consortia will require a standardised approach that is integrated and aligned with current industry best-practice, namely the PAS 2035 standard. It is recommended that a working group for this standard setting body is convened including stakeholders such as DCC, DNOs (including ENWL), DESNZ, Retrofit Providers, Contractors and Public Bodies (inter alia). It is

recommended that a draft standard is produced for consultation, application and revision at the earliest opportunity. It is recommended that this is convened with the support of DESNZ and the BSI, although it is recommended that an aggregator (Super-ESCO) or an established Retrofit Provider (such as Carbon Co-op) initiate these conversations.

2. **Stakeholder Engagement and Collaboration:** Collaboration among stakeholders is key to overcoming barriers and driving systemic change in the energy efficiency sector. It is recommended that an aggregator facilitate targeted engagements to prompt the sharing of resources, expertise, and best practices for MES adoption.
3. **MES Methodology Development:** Future work will need to be taken through innovation funding to create a mechanism for providing aggregated 'comparison group' smart meter data on an ongoing basis for more property typologies. It is recommended that Energy Systems Catapult, who have been working on the MES Methodologies to date, should continue to consult with the RetroMeter consortia to identify ways to access data through the DCC and how to optimise the utilisation of platforms such as Perse, the Living Lab, SERL and Hildebrand. Through further innovation funding, it is recommended that Energy Systems Catapult turn the code for the methodologies into open-source packages.

2-5 Year Time Horizon

1. **Creation of MES Fund:** The details of which have been covered in Work Package 3, Milestone 2 report. It is recommended that this be facilitated through financial consultants, such as EP Group, who will need to engage with relevant governing bodies, financial institutions, and anchor organisations to create an Aggregator (Super ESCO-like entity) that manages the MES Fund.
2. **Capacity Building and Skills Development:** Once the MES methodology has been fully developed, the code has been turned into open-sourced packages, and a standard has been formalised and published, building capacity and expertise among stakeholders will be essential for the successful implementation of MES business models. It is recommended that retrofit facilitators develop training programmes, workshops, and knowledge-sharing platforms for energy professionals, contractors, building owners, and policymakers to enhance their understanding of MES technologies, methodologies, and best practices. It is also recommended that retrofit facilitators invest in education and skills development to empower stakeholders to effectively plan, implement, and monitor MES projects. This activity will need funding from institutional funders, which can be unlocked through the aggregator.
3. **Demonstration Projects and Pilot Programmes:** It is recommended that the aggregator, and their roster of retrofit facilitators, demonstrate the benefits and feasibility of MES through funding and delivering large-scale pilot programmes and exemplar projects, which will build the datasets required to increase the accuracy of the MES methodologies, whilst building confidence and momentum for wider adoption.
4. **Technology Innovation and Data Infrastructure**: Advancements in smart meter penetration play a crucial role in enabling MES implementation. It is recommended that retrofit facilitators and the developers of the MES methodologies, Energy Systems Catapult, engage with the DCC, smart meter technology providers and policy

makers to prompt more resilient data infrastructure and interoperable systems to facilitate data collection, sharing, and analysis for MES projects.

5. **Policy Support and Regulatory Frameworks:** Government support and clear regulatory frameworks are essential for fostering an enabling environment for MES adoption. Adoption could be encouraged by requiring ECO to trial an MES approach in the first instance. It is recommended that national government schemes on energy efficiency and residential retrofits are leveraged as a key pathway to upscaling MES-enabled retrofits. For example, under the ECO scheme, Ofgem will need to signal their intent to consult on whether energy suppliers should be required to report on metered energy savings for certain ECO interventions.

5-10 Year Time Horizon

1. **Development of Data Warehouse:** The details of which have been covered in Work Package 3, Data Warehouse Proposal Report. Developing a data repository that satisfies all the function requirements as detailed in the report will be complex, and therefore, it is recommended that the Energy Systems Catapult and / or retrofit facilitators establish a steering committee to engage with the DCC, institutional funders, anchor organisations, relevant policy makers and in some cases, target householders, to determine the data model specification, categorise core and future functions/services & discuss a self-sustaining funding solution. This help to assess the feasibility of developing the data warehouse, after which it is recommended the steering committee identify stakeholders to assist with the piloting and development of the data warehouse and assess the ancillary functions as specified in the Data Warehouse Proposal Report.
2. **Building capacity in the finance sector:** The main hypothesis behind MES is that it can increase access to financing. In order to test this hypothesis, it is recommended that the aggregator engage further with mortgage lenders, green lenders and impact investors to build understanding and capacity around the MES approach and the Pay for Performance models behind this, so that the finance sector sees the advantages, and then drives adoption.
    a. A pathway to getting the finance sector involved could be through the Aggregator and relevant policy makers lobbying to incorporate MES methodologies under the affordability assessment stage for commercial loans such as home improvement loans, so that loans can be evidenced around the retrofits and energy billings.
    b. If the data warehouse was able to be developed, such that it could collect, store and categorise data on both energy savings and carbon emission reductions from retrofits, this would provide a strong enough incentive to engage with green lenders for more attractive green loan products.
    c. Metered energy savings could also be uses to assess the affordability with mortgage lenders. For example, purchasing an energy efficient home might incentivise them to offer more beneficial rates.

Ultimately, success in scaling across the adoption chasm requires a flexible and iterative strategy, with stakeholders needing to reassess and refine approaches based on customer feedback, market dynamics and the political landscape around smart meter adoption and

data sharing. The ability to balance innovation with mass-market appeal will determine the sustained growth and longevity of business model.

Section 4: Summary of Adoption & Scale-Up Plan

Summary and Conclusions

In conclusion, this report explored the key barriers and challenges associated with the adoption and scaling up of the Retrometer business model in UK, and proposed approaches to overcome these barriers. The barriers include low smart meter penetration in the residential market, limited technical expertise and lack of consumer trust in the financial models.

Building on MS1 and MS2 reports, which highlight the value streams and benefits from MES, including enhanced accuracy in energy savings measurement, distribution of risks and responsibilities among stakeholders and standardisation, this report assumes that a MES standard has been established and accepted by industry stakeholders as a prerequisite to wide scale adoption and upscaling of the Retrometer business model. Drawing on insights from successful MES implementations in the US, then, the report presents actionable recommendations for scaling up MES business models across different sectors and regions. By leveraging regional and national initiatives aimed at promoting energy efficiency in the UK residential market, the report advocates for a collaborative approach between a centralised actor, such as an aggregator, and the retrofit facilitators to accelerate the adoption of MES and drive systemic change in the energy efficiency landscape.

Concerted efforts from the aggregator, policymakers, industry stakeholders, financiers, retrofit facilitators and communities alike will be required to promote the wide-scale adoption of the business model. Collaboration between the different stakeholders will likely be facilitated through a centralised entity, such as an Aggregator. Some examples of potential agencies that could roll out the Retrometer business model in the UK are:

- The United Kingdom Infrastructure Bank Technical Assistance Facility
- A commercial bank with residential lending portfolio
- An Energy Service Company (ESCO) such as Ameresco or ECOSURV
- A Public-Private Partnership or Entity

To conclude, in order to further develop MES the following streams of work are recommended:

1. Engagement with more stakeholders including government, Ofgem, more DNOs and energy suppliers to build a larger coalition.
2. Further refinement and final determination of the metering methodology.
3. Changes to marketing strategies to increase smart meter penetration and willingness to participate in retrofit schemes.
4. Pilot projects in various situations covering a range of properties and scales.

Funding to continue the work of the RetroMeter project should be sought from a variety of potential sources. Initial funding could be relatively low level as it will be focused on further engagement and further refinement of the metering methodology.

Apart from the residential sector, there is scope for MES enabled projects in other sectors, including commercial buildings, industrial facilities and public institutions. These projects could demonstrate where MES works best and serve as models for replication and scale-up across different sectors and regions through actuarial data collection through the data warehouse.

Ultimately, the wide-scale adoption and scaling up of the Retrometer business model holds significant potential to transform the UK's energy sector, promote sustainable development, and pave the way towards a low-carbon future.

Section 5: References

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (2002). *ASHRAE Guideline Measurement of Energy and Demand Savings.* [online] Available at: https://www.eeperformance.org/uploads/8/6/5/0/8650231/ashrae_guideline_14-2002_measurement_of_energy_and_demand_saving.pdf [Accessed 15 Mar. 2024].

BS 7671 - 18th edition (2024) *Home*. Available at: https://electrical.theiet.org/bs-7671/ (Accessed: 27 March 2024).

Department for Energy Security and Net Zero (2023*). Retrofitting dwellings for improved energy efficiency – Specification and guidance*. [online]. Available at: https://www.bsigroup.com/siteassets/pdf/en/insights-and-media/insights/brochures/pas_2035_2023.pdf. [Accessed 15 Mar. 2024].

Department for Energy Security and Net Zero (2022*). Green Homes Grant Local Authority Delivery scheme, Phase 2: funding allocated to Local Net Zero Hubs*. [online]. Available at: https://www.gov.uk/government/publications/green-homes-grant-local-authority-delivery-scheme-phase-2-funding-allocated-to-local-net-zero-hubs. [Accessed 15 Mar. 2024].

Diffusion Research Institute (2023). *Chasm Theory Development: The Complete History*. [online] Available at: https://diffusion-research.org/research_articles/chasm-theory-development/. [Accessed 15 Mar. 2024].

Edwards, J. (2019). *New standards in retrofit: PAS 2035*. [online] RICS. Available at: https://ww3.rics.org/uk/en/journals/built-environment-journal/new-standards-in-retrofit-pas-2035.html [Accessed 15 Mar. 2024].

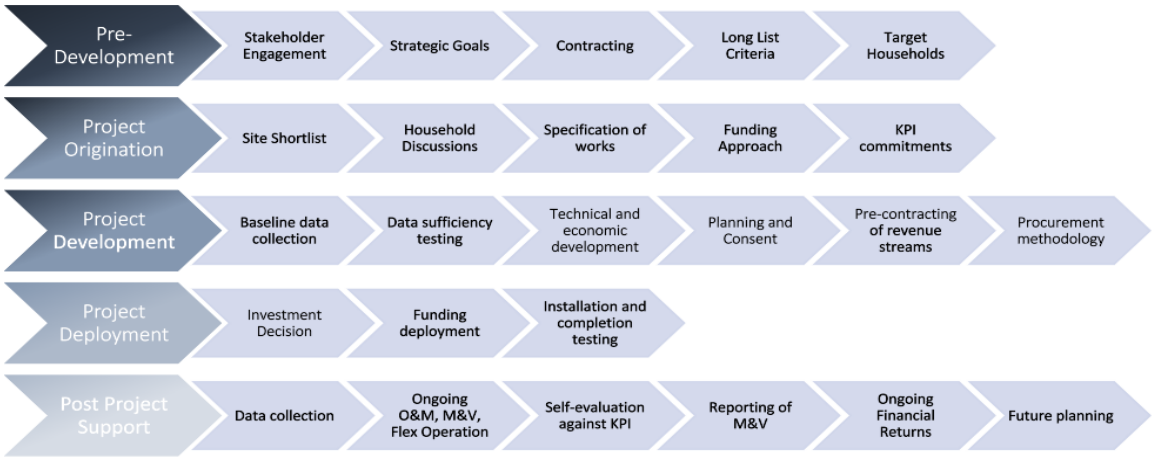
GOV.UK. (n.d.). *Apply for help to improve a home with no gas boiler (Home Upgrade Grant)*. [online] Available at: https://www.gov.uk/apply-home-upgrade-grant [Accessed 15 Mar. 2024].

Lipscomb, B. (2018). *How Meter-Based Savings Lead to New Opportunities - green HVACR*. [online] Available at: http://greenhvacrmag.com/2018/meter-based-savings/ [Accessed 15 Mar. 2024].

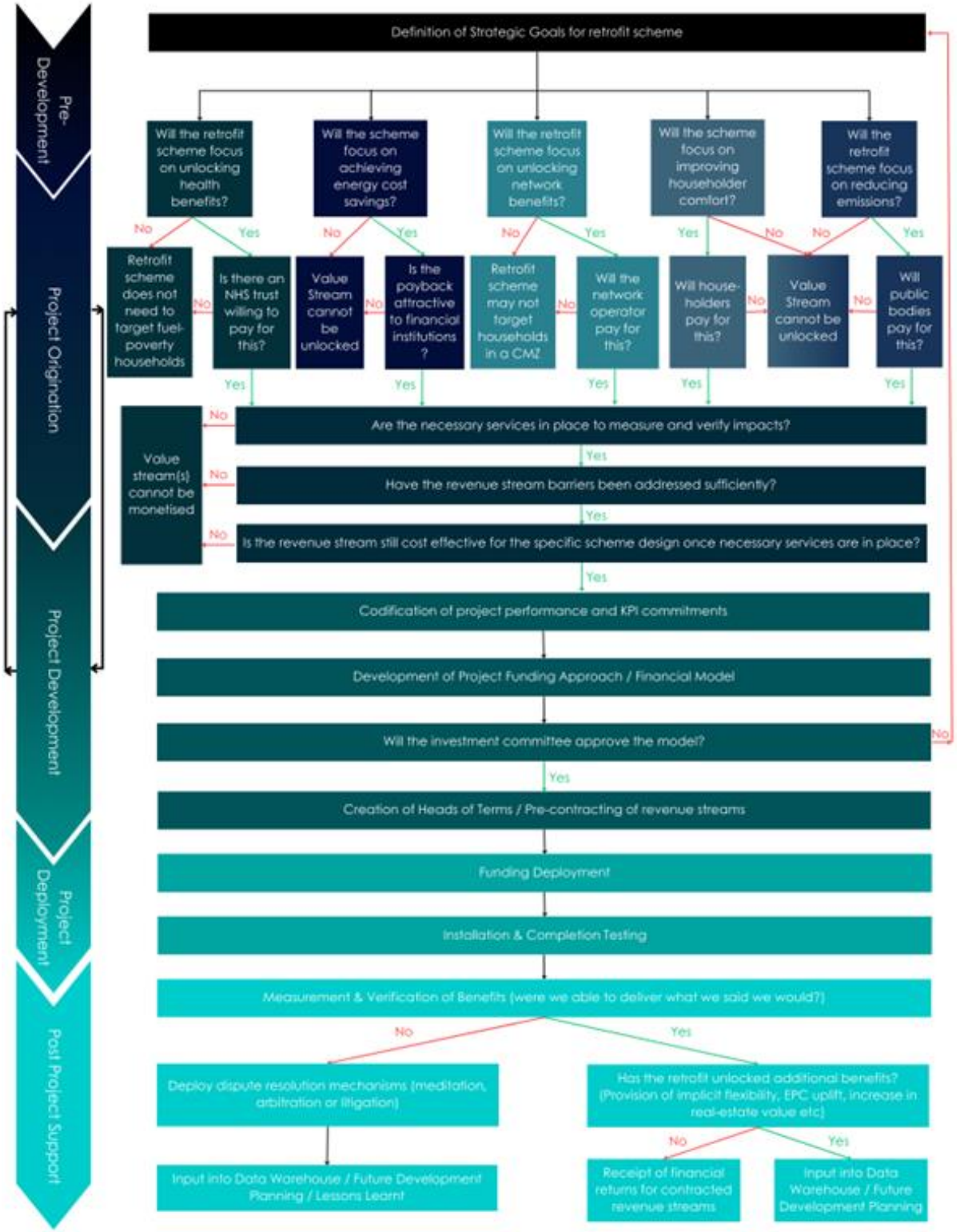
Ofgem (n.d.). *Energy Company Obligation (ECO)*. [online] Ofgem. Available at: https://www.ofgem.gov.uk/environmental-and-social-schemes/energy-company-obligation-eco.

Generic Committee reference used for BSI standards ... (2024) BSI Group. Available at: https://standardsdevelopment.bsigroup.com/committees/50079215 (Accessed: 29 March 2024).

Appendix 1


Pre-Development
Stakeholder Engagement
Strategic Goals
Contracting
Long List Criteria
Target Households
Project Origination
Site Shortlist
Household Discussions
Specification of works
Funding Approach
KPI commitments
Project Development
Baseline data collection
Data sufficiency testing
Technical and economic development
Planning and Consent
Pre-contracting of revenue streams
Procurement methodology
Project Deployment
Investment Decision
Funding deployment
Installation and completion testing
Post Project Support
Data collection
Ongoing O&M, M&V, Flex Operation
Self-evaluation against KPI
Reporting of M&V
Ongoing Financial Returns
Future planning

Appendix 2


Pre-Development
Project Origination
Project Development
Project Deployment
Post Project Support
Definition of Strategic Goals for retrofit scheme
Will the retrofit scheme focus on unlocking health benefits?
Will the scheme focus on achieving energy cost savings?
Will the retrofit scheme focus on unlocking network benefits?
Will the scheme focus on improving householder comfort?
Will the retrofit scheme focus on reducing emissions?
Retrofit scheme does not need to target fuel-poverty households
Is there an NHS trust willing to pay for this?
Value Stream cannot be unlocked
Is the payback attractive to financial institutions ?
Retrofit scheme may not target households in a CMZ
Will the network operator pay for this?
Will house-holders pay for this?
Value Stream cannot be unlocked
Will public bodies pay for this?
Value stream(s) cannot be monetised
Are the necessary services in place to measure and verify impacts?
Have the revenue stream barriers been addressed sufficiently?
Is the revenue stream still cost effective for the specific scheme design once necessary services are in place?
Codification of project performance and KPI commitments
Development of Project Funding Approach / Financial Model
Will the investment committee approve the model?
Creation of Heads of Terms / Pre-contracting of revenue streams
Funding Deployment
Installation & Completion Testing
Measurement & Verification of Benefits (were we able to deliver what we said we would?)
Deploy dispute resolution mechanisms (mediation, arbitration or litigation)
Input into Data Warehouse / Future Development Planning / Lessons Learnt
Has the retrofit unlocked additional benefits? (Provision of implicit flexibility, EPC uplift, increase in real-estate value etc)
Receipt of financial returns for contracted revenue streams
Input into Data Warehouse / Future Development Planning
Yes
No

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